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An Analysis of Successful and Unsuccessful Farm Loans in South Dakota

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ABSTRACT

Low farm production and high cost of operation were the most common causes of unsatisfactory loan experience among a sample of South Dakota farm borrowers. The study, which dealt with loan cases on 100 Farmers Home Administration and 100 production credit association borrowers, also showed that high ratios of debt to assets and non-real estate debt to total debt were closely related to farm debt failure. Discriminant functions were used in a statistical analysis of the study data. This analysis also allowed use of an additional statistical technique to rank loan failure causes by importance.

Keywords: Farm debt failure; FHA loans; PCA loans; South Dakota.

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SUMMARY

A record of low farm production and high operating costs per unit of output were the more common characteristics related to unsuccessful farm loan cases among South Dakota borrowers. Other unfavorable characteristics appearing often were a high ratio of debt to assets, a high ratio of non-real estate to total debt, and a large number of persons in the household.

Information from the Farmers Home Administration (FHA) and production credit associations (PCA's) on 200 farmers who borrowed during 1955-65 showed that at the time of the borrower's first loan application, there were no significant differences in selected borrower characteristics. However, at the time of the last loan application, half the loan cases were unsatisfactory in terms of repayment. A comparison of borrower characteristics at the time of the first and last loan applications indicate that all borrowers were initially worthy of a farm loan in the opinion of the lender, but that certain unfavorable characteristics became apparent or developed as the loan period progressed.

There were almost no differences between the ages of successful and unsuccessful borrowers. Unsuccessful borrowers averaged a few more years of farming experience and engaged in more off-farm work than successful borrowers did, and on the average, had lower educational levels. But these differences were slight compared with the differences in production records, operating costs, and other characteristics mentioned above.

AN ANALYSIS OF SUCCESSFUL AND UNSUCCESSFUL
FARM LOANS IN SOUTH DAKOTA

by

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INTRODUCTION

Credit in some form is used by most U.S. farmers. Farm loan size ranges from a few hundred to over a million dollars. Most farmers use their credit and repay their loans satisfactorily. This study is concerned with the comparatively small percentage of borrowers who are not successful in using and repaying their loans.

There are many causes of the difficulties farmers encounter in satisfactorily handling their farm loans. General economic conditions, price levels for farm products, and widespread national disasters such as drought are well-known causes of loan failure. Other causes are more closely related to the individual borrower and the farm he operates. This study of farm borrowers in South Dakota is directed to the latter type and specifically to problems that develop after loans have been in progress at least a year or so.

Purpose and Objectives

Since a certain amount of risk is always involved in any loan, it would be well if there were some way of determining the probability of a loan succeeding before the loan is made. It would also be helpful to recognize developing trouble early enough during the history of a loan so that corrective action might be taken, thereby averting an unsatisfactory situation for the borrower or the lender.

The purpose of this study was to try to identify certain factors or characteristics of the borrower that would indicate an unsatisfactory loan situation was developing. The study was concerned with developments after the first loan from a particular lender rather than with the question of whether data available to the lender at the time of the first loan application were correctly evaluated.

Although not every factor identified as being an indicator of potential loan failure would be applicable in every case, lenders might use such guides to advantage along with other information they may have relative to particular situations.

Only users of farm-operating loans were included. Such loans are mainly used for 1 year. However, some loans used for purchasing machinery or other capital purpose items may have planned maturities of up to 7 years.

Collection of Data

Area studied: The Farmers Home Administration (FHA) and the Federal Intermediate Credit Bank of Omaha cooperated with the Economic Research Service (ERS) in conducting this study of farm loans in South Dakota. Data were gathered in the summer of 1965. The study area was within the lending boundaries of five production credit associations (PCA's) (fig. 1). Two FHA offices in each of the five PCA areas supplied data about their borrowers. Only loans by FHA and PCA's were studied because loan and borrower data kept by commercial banks, merchants and dealers, and other farm lenders in many cases lacked the completeness and comparability necessary for this analysis.

Number of cases: A total of 200 loan cases were studied in detail--100 FHA loans and 100 PCA loans. Each PCA office supplied 20 cases and each FHA office supplied 10 cases. One-half of the loan cases from each office were characterized as successful and the other half unsuccessful in terms of satisfactory repayment. The study cases, therefore, were composed as follows:

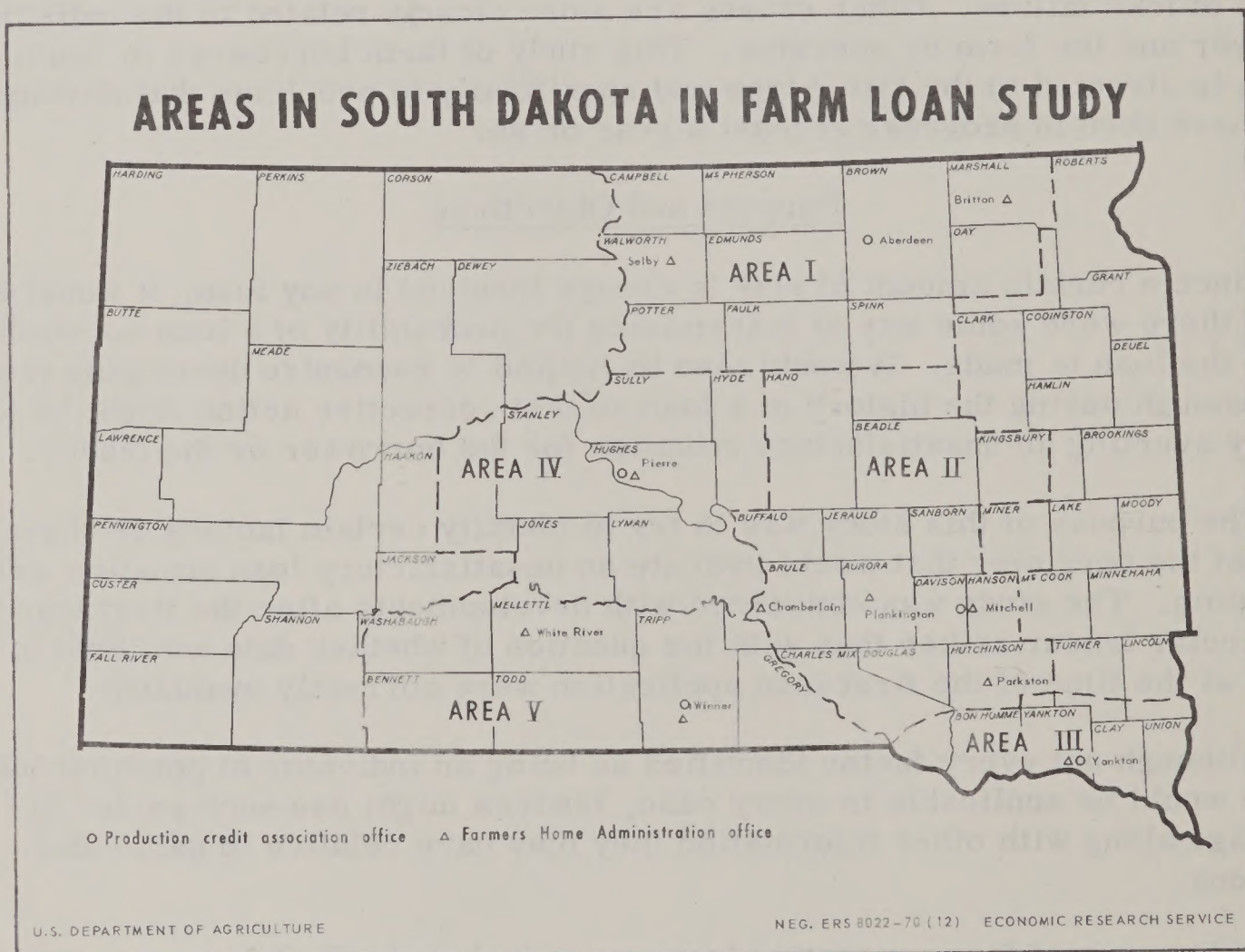| Lender	Successful	Unsuccessful	Total
FHA (10 offices)	50	50	100
PCA (5 offices)	50	50	100
Total	100	100	200

Figure 1

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Criteria for selecting the sample of unsuccessful borrowers were that the borrower: (1) was in serious financial difficulty at the time of the study; (2) got into difficulty while borrowing from the lender in question; or (3) got into difficulty at some time within 8-10 years before the time of the study, but before 2 years before the study date. Financial difficulty meant that loan repayments were badly off schedule and future payments would most likely be extremely difficult to make. The main criteria for successful borrowers were that the borrower: (1) was in sound financial condition or rapidly showing improvement at the time of the study; (2) began showing improvement while borrowing from the lender in question; or (3) began showing improvement within 8-10 years before the time of the study, but before 2 years before the study date.

Sampling: The study cases were not chosen by a random method of selecting a representative sample of all FHA and PCA borrowers in the study area. It was more important that the data represent successful and unsuccessful borrowers. The analysis did not depend on relative proportions of FHA and PCA borrowers.

The FHA county supervisor and the PCA manager in the respective locations were asked to choose an equal number of loan files on successful and unsuccessful borrowers. This meant 10 of each from the five PCA's and usually five of each from the 10 FHA's.

The 2-year time limit in the sample criteria was to avoid the possibility of choosing unusual cases where difficulty arose or rapid improvement took place within a year or so prior to the time the study began. Otherwise, it would not be possible to be confident that the cases were genuinely successful or unsuccessful because the change may have been too short lived to be proven. The longer time limit more nearly assured complete and comparable information about the loan cases.

An effort was made to exclude from the sample those loan cases that were doubtful or borderline as to success. Only cases that were believed to be definitely in one class or the other were desired.

Source of information: Histories of each of the 200 loan cases were traced in detail. Loan applications, farm and home plans, investigation reports, repayment records, and written comments by office personnel were gleaned for information. The FHA county supervisors and PCA managers supplied certain information requested on a printed questionnaire. To double-check information from the loan files and to gather other pertinent information, the loan officers were interviewed by the researchers. Borrowers were not interviewed--all information was obtained from loan files and interviews with the FHA or PCA loan officers. Borrower cases were coded to be identifiable to the loan officer but not to the researchers.

The FHA records contained more detail and more data items than did the PCA records, especially on farm yields, production, income, and expenses. However, PCA managers were well informed about the circumstances of their borrowers.

The sample was selected to include the more important types of farms or ranches in the respective areas. Farm types ranged from crop farms in the southeast area of South Dakota to crop and livestock farms in the east and northeast

to predominantly range livestock ranches in the central and south central areas. Farm and ranch sizes ranged from 80 to over 5,000 acres. Small, medium, and large units were included. Only borrowers with farm-operating or intermediate-term loans were sampled. Some also had long-term real estate loans but none were selected who had only long-term loans.

Types of data: All the sample cases were family farms. Inherent in most such business units is an inseparable bond between the farm business and farm family activities. This connection adds to the difficulties of analyzing the operation of the farm as a business unit or a separate entity. What affects the farm firm usually also affects the farmer's family and vice versa. Therefore, an analysis of just the physical farm plant is not sufficient to arrive at reasons for varying degrees of loan success or failure. Personal characteristics of the farmer and his family, and possibly social customs in the community, are telling influences on the farm business. That no two farms are exactly alike complicates the analysis. Thus, farmers probably will not react the same when confronted by similar problems

Therefore, data collected on the sample loan cases were of two kinds: (a) personal characteristics of the borrower and his family, and (b) financial statements and other quantitative information on the farm business.

FHA county supervisors and PCA managers furnished most of the personal data. Some items--such as those relating to management ability, production records, changes in the number of persons in the farmer's household, condition of land and buildings, and how well the borrower cooperated with the lender on points of mutual interest--covered the whole time period of each loan case history.

Among the questions that related to the last year of the loan or to the time the questionnaire was answered were questions about age, marital status, help received from household members in doing farm work, number of acres cropped or grazed, and whether the borrower usually had off-farm work.

Although only a few questions, such as level of formal education, related to the time of the first loan received from the present lender, other data items relating to the time of the first loan could be determined. For example, age of borrower the year he began farming, type of farm, and whether the farm business was an individual undertaking or a partnership, could be deduced from the answers on the questionnaire.

Financial Statements

Data about particular assets and debts were obtained from the farm and home plan for FHA borrowers and from the loan application form for PCA borrowers. In practically every case, there was an annual financial statement. Most were either as of January 1 or close enough to January 1 to be considered as of that date. Often there were financial statements for other times during the year, usually in connection with a request for an additional loan. However, the main information was supplied the lender in the statement given around the first of the year.

Most of the data in the financial statement were accepted as shown by the borrower. Undoubtedly some asset values were inflated--especially real estate. In each case, the lending officer was questioned as to the validity of the asset values. In all but a few cases, he substantiated the values as found in the financial statement. Usually he or another member of the office staff had gone over the figures with the borrower at the time the statement was submitted, so the occurrence of major errors was minimal. In cases where it appeared asset values were too far out of line, the values were changed to a more reasonable figure.

Besides the financial information, background information in the file often indicated acreage farmed, whether land was owned or rented, and type of farming operation. The statements of FHA borrowers contained types of information not found in the PCA applications. The FHA files contained a history of the previous year's farming costs, farm and off-farm income, and production. Estimates of the coming year's costs and returns were also given. Little, if any, such information was kept in the PCA files.

Having financial statements and related data on an annual basis allowed analysis over the time period from first to last loan application. Changes in assets, debts, various ratios, and incomes (for FHA borrowers) could be measured.

Lender Differences

The Farmers Home Administration makes farm-operating loans to applicants unable to obtain such loans elsewhere on reasonable terms. When circumstances of FHA borrowers improve sufficiently, they are encouraged to "graduate" to other lenders. Production credit associations make loans similar in overall quality to those of commercial banks. One might expect, then, that the financial health of FHA and PCA borrowers would be somewhat different, especially in the first year of the loan. Nevertheless, whatever the apparent differences in quality of new FHA and PCA loans, both lenders have unsuccessful and successful borrowers.

In addition to agency differences between FHA and PCA's, there are also differences among individual FHA county supervisors and among PCA managers. Probably no two loan officers would appraise the same situation or handle a given circumstance in exactly the same way. In this study, these human behavioral differences were recognized. Subjective information was accepted and evaluated as such. All information was weighed and few major adjustments were believed necessary. It is possible that the use of subjective data introduces some bias into the study. Since borrowers were not interviewed, some information supplied by the lender may be influenced according to the lending officer's philosophy or limited knowledge of the case. In studies such as this where human judgment is heavily involved, it is practically impossible to completely eliminate such biases. Nevertheless, it is important that the researcher recognize the existence of such opinions and use them with full knowledge of what they are and how they may influence results.

Time Period

Data on the loans covered the time period that began with the first application with the FHA or PCA lender and ended with the last application or financial statement. For most borrowers, the latest data were for the first half of 1965. For a few borrowers, the loan had become inactive, either permanently or temporarily, through repayment or otherwise, sometime during late 1964.

Analysis

Data collected for the study offered numerous credit factors and other items for analysis by statistical methods. A linear discriminant function was used for the analysis. A detailed discussion of the formula and statistical procedure is presented in the appendix. Other data and information not so well adapted to statistical treatment were evaluated in a less sophisticated manner.

RESULTS

To test for differences between characteristics of successful and unsuccessful borrowers, the sample cases were divided into three groups. One grouping, which combined the FHA and PCA borrowers, compared all 100 successful borrowers with all 100 unsuccessful borrowers. Two other groupings compared (1) successful FHA borrowers with unsuccessful FHA borrowers, and (2) successful PCA borrowers with unsuccessful PCA borrowers; from these two groups, differences between successful and unsuccessful borrowers by lender could also be observed.

The data were analyzed by using a discriminant function statistical technique and by observing the number of times various factors appeared in a simple tabulation.

In the statistical method, for all borrowers, 15 selected characteristics or factors were used in testing data as of the year of the last loan application. The same factors were used in testing the FHA and PCA borrowers as separate groups--again, as of the year of the last loan covered in the study. An additional analysis that compared all successful borrowers with all unsuccessful borrowers used data as of the year of the first loan application. In this analysis, 23 factors were used. Here the test was to see if any differences existed between the success groups as their loans began.

In the analysis based on the less sophisticated method, certain information-- including some items used in the statistical tests--was tabulated and analyzed.

FHA and PCA Borrower and Loan Characteristics, Year of Last Loan

Analysis of 15 selected characteristics of the 100 successful and 100 unsuccessful FHA and PCA borrowers in the year of their last loan application revealed measurable differences between the two success classes. Table 1 shows the variables used in the statistical analysis by their relative rank of importance.

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Table 1.--Variables tested and results obtained in a discriminant analysis of
100 FHA and 100 PCA farm loan borrowers, South Dakota, 1965

Variables tested	All borrowers			FHA borrowers			PCA borrowers		
	Rank	D^2 1/	W 2/	Rank	D^2 1/	W 2/	Rank	D^2 1/	W 2/
Low production record...:	1	5.6176	.2181	1	7.3923	.2884	3	6.6653	.0932
High per unit cost of operation...........:	2	5.9387	.1734	2	7.8851	.2409	2	6.6541	.0948
High ratio of non-real estate debt to non-real estate assets.....:	3	6.7672	.0580	4	9.8203	.0546	8	7.2376	.0262
Larger number persons in household...........:	4	6.9131	.0378	6	10.1349	.0243	5	7.0078	.0572
High ratio of non-real estate debt to total debt.............:	5	7.0205	.0228	3	9.7426	.0621	7	7.1716	.0351
Low ratio of net worth to total assets owned (equity ratio).........:	6	7.0776	.0148	5	9.9586	.0413	14	7.4311	.0002
Longer farming experience............:	7	7.0951	.0124	7	10.1396	.0239	15	7.4323	.0001
Suffered weather damage.:	8	7.1177	.0092	12	10.3224	.0063	11	7.2939	.0187
Received family help....:	9	7.1356	.0068	11	10.2966	.0088	6	7.0414	.0526
Age of borrower.........:	10	7.1518	.0045	14	10.3807	.0007	10	7.2852	.0199
High ratio of total debt to net worth......:	11	7.1562	.0039	9	10.2612	.0122	4	6.8417	.0795
Less formal education...:	12	7.1669	.0024	15	10.3815	.0006	13	7.4305	.0005
High ratio of total debt to total assets owned..................:	13	7.1747	.0013	10	10.2749	.0109	1	6.4950	.1262
High ratio of total debt to total assets operated...............:	14	7.1785	.0008	8	10.2212	.0160	9	7.2622	.0229
Having off-farm income..:	15	7.1804	.0005	13	10.3680	.0019	12	7.3597	.0098
All variables...........:	---	7.1841	---	---	10.3877	---	---	7.4327	---

1/ Mahalanobis $D^2 = \dfrac{(\bar{Z}_A - \bar{Z}_B)^2}{S_Z^2}$

2/ $W = 1 - \dfrac{D_p^2 - 1}{D_p^2}$

Where p = number of variables in the discriminant function.

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The Mahalanobis D^2 in the table measures the amount the given variables in the discriminant function explain of the differences between the two groups being tested. The W statistic measures the relative amount of the total D^2 for all variables that can be attributed to any given variable.[1]

The most important factors associated with unsuccessful loans were: (1) a low production record, (2) high cost of operation, (3) a high ratio of non-real estate debt to non-real estate assets, (4) a larger number of persons in the household, and (5) a high ratio of non-real estate debt to total debt.

The borrower's production record over the life of the loan was the most important factor between the two success groups. Successful borrowers were more likely to have higher records of production per acre or per unit of livestock than were unsuccessful borrowers. It is logical that the production factor should rank high in importance, if not highest. Loans have to be repaid from the farm's production. If salable goods are not produced in sufficient quantities, not enough money will be available for loan repayment.

Borrowers who had a history of high operating costs relative to level of production were likely to be unsuccessful in loan repayment. This factor may often be harder for lenders to measure than production. Most costs of farming are distinct enough to be accounted for fairly accurately. However, some costs, which in many cases are sizable amounts, are accumulated in relatively small sums and at odd times, making them hard, or at least inconvenient, to keep up with. Nevertheless, total costs have to be accounted for sometime. A situation of consistently high costs relative to production could very well lead to financial difficulty.

A high cost of operation per unit of output and a poor production record are not necessarily related. A farm borrower could have either attribute or both. That poor production and high cost of operation per unit both rank high as factors associated with unsatisfactory borrowers, however, indicates the two often appear together.

A high ratio of total non-real estate debt to the value of non-real estate assets ranked third as an indicator of poor loan history. It was the only one of the financial ratios usually thought of as loan quality indicators (such as debt to assets, net worth to assets, and debt to net worth) that showed an important difference between borrowers by success class.

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[1] The W statistic measures the ratio of the D^2 with the given variable in the function to the D^2 with the given variable eliminated from the function. This measures the relative importance of the given variable as an explanatory variable (see appendix for more complete information). For example, of the total difference between the groups explained by all 15 variables, using all 100 observations, production record accounted for 38 percent and high cost of operation for 31 percent, with the ratio of non-real estate debt to non-real estate assets accounting for 10 percent.

Most farm non-real estate debt is incurred for day-to-day operating expenses. The amount of such debt may have a closer connection to the farming operation than does real estate debt. This close relationship may account for its sensitivity to loan quality. In this particular study, not all borrowers owned farmland or owed on a loan secured by farm real estate. However, each sample borrower had a non-real estate or farm operating loan and each owned non-real estate assets.

The number of persons in the borrower's household ranked fourth in importance as a factor influencing loan success. Larger families tended to show a definite relationship to the unsuccessful loan class. This variable gives one indication of the relative portion of total income spent for family upkeep. As a rule, larger families require larger portions of the total income for living expenses, thereby leaving less for farm operations and debt repayment.

Unsuccessful borrowers had a higher ratio of non-real estate debt to total debt. This factor ranked fifth. That this variable and also the high ratio of non-real estate debt to non-real estate assets appeared among the top five factors emphasizes the relationship of non-real estate debt to the farming operation.

Two traditional indicators of loan quality--the ratio of debt to total assets and ratio of net worth to assets--did not rank among the top five. Another ratio thought to offer potential as an indicator rated poorly. This was ratio of total debt to value of assets operated (value of owned assets plus the value of land rented in); it ranked near the bottom.

FHA Borrower and Loan Characteristics, Year of Last Loan

The more important characteristics of unsuccessful FHA sample cases were: (1) Poor production record, (2) high cost of operation, (3) high ratio of non-real estate debt to total debt, (4) high ratio of non-real estate debt to value of non-real estate assets, and (5) low ratio of net worth to value of total assets owned.

The high correlations between non-real estate debt and total debt and between non-real estate debt and value of non-real estate assets among FHA borrowers may be related to the low incidence of farmland ownership. At the time of their last loan application, 46 percent of the unsuccessful and 36 percent of the successful FHA borrowers owned no farmland. Therefore, a large portion of FHA borrowers had no farm real estate assets or debts secured by farm real estate. All had non-real estate assets and debts.

A low ratio of net worth to value of total assets owned (equity ratio) ranked much higher as an indicator of unsuccessful loans among the FHA borrowers than among the PCA borrowers. Because many FHA borrowers' assets and debts (and therefore net worths) were non-real estate oriented, the ranking of the equity ratio approximated those of the ratio of non-real estate debt to total debt and the ratio of non-real estate debt to value of non-real estate assets.

For FHA borrowers, the differences between success classes in the number of persons in households and years of farming experience were not large enough to be reliable indicators of loan success. The ratios of total debt to net worth, total debt to value of assets operated, and total debt to value of assets owned ranked lower than the importance lenders usually give these indicators of loan quality.

PCA Borrower and Loan Characteristics, Year of Last Loan

When PCA sample cases were analyzed separately, the more important factors associated with unsuccessful borrowers were: (1) A high ratio of debt to assets owned, (2) high cost of operation, (3) poor production record, (4) a high ratio of debt to net worth, and (5) larger number of persons in the borrower's household.

The most notable difference between PCA and FHA borrowers was that in the PCA cases, the ratio of total debt to value of total assets owned appeared as the most important factor of loan quality. This may be partially explained by the larger percentage of PCA borrowers owning farmland at the time of their last application or financial statement. Unsuccessful PCA borrowers owned farmland in 78 percent of the cases, compared with 54 percent of the unsuccessful FHA borrowers. In successful cases, 92 percent of PCA borrowers owned farmland, compared with 64 percent of FHA borrowers. For borrowers who owed a debt secured by farm real estate, the amount of such debt averaged higher than did that of non-real estate debt. This emphasis given real estate probably gave more importance to the ratios that included total debt than to ratios that included only non-real estate debt.

Whether or not a borrower received help from his family ranked higher for PCA borrowers than for FHA borrowers or all borrowers combined. More successful than unsuccessful PCA borrowers had received substantial help from their families.

For PCA borrowers, ratios of non-real estate debt to total debt and non-real estate debt to value of non-real estate assets rated low as indicators of loan quality. The ratio of total debt to value of assets operated showed no more potential of being a strong factor for PCA borrowers than it was for FHA borrowers.

FHA and PCA Borrower and Loan Characteristics, Year of First Loan

When a lender and borrower agree on the amount, terms, and other details of a farm loan, in practically all cases both parties have reasonable expectations that the subsequent life of the loan will be satisfactory. However, plans and circumstances change over time and some satisfactory farm loan arrangements turn out unsatisfactorily. Certain loan and borrower characteristics were analyzed to see if at the time of the first loan application many such characteristics were different for loan cases that later turned out to be successful or unsuccessful.

Twenty-three factors, including most of those analyzed as of the year of the last application, were tested in several mixes for differences between the 100 unsuccessful loans and the 100 successful loans. 2/ The variables tested are as follows:

2/ There were no statistically significant differences between the unsuccessful and successful groups for any of the variable mixes.

Age
Number of persons in borrower's household
Off-farm income
Received family help
Education

Number of years farming before first loan application
Number of acres operated
Value of land operated
Value of non-real estate assets
Total value of assets owned

Value of assets operated
Total non-real estate debt
Total debt
Net worth
Net worth/Value of total assets owned

Total debt/Net worth
Net worth/Non-real estate assets
Non-real estate debt/Net worth
Non-real estate debt/Total debt
Other non-real estate debt/Total non-real estate debt

Total debt/Total assets owned
Non-real estate debt/Non-real estate assets
Total debt/Total assets operated

Regardless of the combinations of factors, there was little difference between success classes. These tests indicate, therefore, that at the time of the first loan application, there were no real differences in the values of the 23 variables between applicants who later turned out to be successful or unsuccessful in handling their farm loans.

Other Analysis and Comments

The foregoing sections dealt with a discriminant function analysis of borrower characteristics and loan factors believed pertinent to the problem involved in this study. Some of those characteristics and factors are further discussed in this section. Also, comments are made on several other factors not included in the statistical tests but which commonly show up in farm loan situations and about which information was collected.

The data referred to in the following subsections are found in table 2. Some data are as of the time of either the first or last loan application, while other information refers to the period from first to last loan application, inclusive. Some of the results in the table are more or less self-explanatory so all items are not discussed.

Much of the information, such as age, acres of rented land, and insurance coverage, is documented in the borrowers' written loan record--especially for FHA borrowers. Additional information was furnished by loan officers from their general knowledge of the borrower and his family. Such information was of a highly subjective nature.

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Age

There was little difference between the average age of FHA and PCA borrowers or between those in the successful and unsuccessful groups. PCA borrowers averaged slightly older than FHA borrowers. The unsuccessful borrowers averaged 42.7 years of age, compared with 40.0 years for those in the successful group. The difference in averages was so small that age would hardly be a factor in whether a borrower would be successful in his loan. And although individual ages ranged from the mid-20's to the mid-60's, the analysis detected no importance in age as a loan quality factor.

Off-Farm Work 3/

Work done by farmers off their own farm and the income derived therefrom may affect operation of farms in different ways. Some farm operators may seek off-farm employment to bring their total income up to what they consider a satisfactory level. Often off-farm income may have to be added to farm income to keep the farm operation viable. For farmers having a successful farming operation, the additional income from off-farm sources may not be a factor in the ability to acquire or repay farm debts. There is the question of whether some of those who seem to have an economically marginal farming operation might make their farm more profitable by putting all their time and effort into it rather than dividing their energies between the farm and an off-farm job. The question becomes a very practical one to lenders, who have to judge a borrower's ability to hold an off-farm job and at the same time carry on a viable farming operation.

In the sample of South Dakota borrowers, off-farm work was more common among the unsuccessful than the successful group. This was true at both the time of the borrowers' first loan application and their last application. In terms of the total number of borrowers working off-farm, there was less difference between the success groups at the time of the first application than at the time of the last.

The pattern was somewhat different, however, when borrowers were grouped as to lender. The number of PCA borrowers who had off-farm work increased between the time of their first application and the time of their last application. The trend was the same for PCA successful and unsuccessful borrowers. For FHA borrowers, the number with off-farm income declined from the time of the first application to the last. This was the case for both success groups, although the drop was sharper for the successful FHA group.

Seven unsuccessful and four successful PCA borrowers had off-farm income at the time of their first and their last loan applications. It was not possible to tell, especially for PCA borrowers, whether the borrowers with off-farm income at the first and last applications also had such income continuously in the interim years.

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3/ Off-farm work was included when engaged in by the borrower or his wife only. Data were available on the amount of off-farm income for FHA borrowers but not for PCA borrowers.

From the information obtained in the survey, one could not say with any amount of certainty that farmers with off-farm work are likely to be poor loan risks just because of the greater prevalence of off-farm income among the unsuccessful borrowers. Indeed, the statistical test found off-farm income of little significance in loan quality. However, it might be a matter for consideration by the lender. As suggested earlier, there is the question of whether the unsatisfactory performance of some borrowers with off-farm income was due to the attention given the off-farm work or whether the off-farm work was necessary because of the unsatisfactory farm financial situation.

Change in the Number of Persons in Household

Three-fifths of the cases in the sample had a change in the number of persons in the household during the history of the loan under study. The successful and unsuccessful groups showed the same percentage of borrowers having a change. In both groups, an average of about two persons were added to the families and about the same number left the families. There were four deaths in the families of the unsuccessful groups. Only in one case did a loss through death severely hurt the farming business. Serious illness during the loan history was experienced by 13 unsuccessful and six successful borrowers. For five of the unsuccessful and two of the successful borrowers, these illnesses were judged to have severely hurt the farm businesses.

Physically Handicapped Borrowers

Ten unsuccessful borrowers and four successful borrowers had serious physical handicaps. Although there were 2-1/2 times as many physically handicapped unsuccessful borrowers as successful, only 10 percent of all borrowers were physically handicapped. One would not, therefore, consider being physically handicapped as a major cause of unsuccessfully handling a farm loan. The exception, of course, would be that in certain cases such a handicap could very well prove to be financially disastrous.

Highest Formal Education

The successful borrowers averaged a higher formal education level than the unsuccessful borrowers. Two-thirds of the successful group had attended high school, compared with 56 percent of the unsuccessful group. Only 10 of the sample had attended college--7 successful borrowers and 3 unsuccessful. Almost 40 percent of the unsuccessful group had not gone beyond elementary school, compared with 26 percent of the successful group. Although PCA borrowers averaged a higher formal education than FHA borrowers did, for both PCA's and FHA the successful borrowers averaged a higher formal education than unsuccessful borrowers did.

It is not the intention here to place values on the various levels of formal education. However, information from other studies indicates that it is advantageous to farmers to be better able to understand more of the technical and economic languages and terms so commonly used in modern agriculture. Training in correctly analyzing the many situations that arise almost daily in farming is important. The art of communicating well with other farmers and with businessmen

regularly contacted in farming is advantageous to farmers and ranchers. Often the farmer with more education has a greater desire to read agricultural reports and publications and thereby profit by them.

It is possible that the education level may already be reflected in such factors as production record and cost of operation. The statistical analysis found the level of formal education to be of minor significance in whether a loan would be successful or not.

Years of Farming Experience

One might expect the length of farming experience to have some effect on the successful handling of farm finances. That is, more experience should result in being a more satisfactory borrower. The data gathered on the sample of South Dakota borrowers indicate that for both FHA and PCA's, the unsuccessful borrowers averaged more years of farming experience before their first loan with the respective lender than did the successful borrowers. Also, the unsuccessful borrowers had, on the average, been farming in their respective area longer than the successful borrowers had. Often lenders question whether farmers can continue successful operations after moving from one farming area to another. With the sample borrowers, no relationship was noted between length of farming experience within an area and farm loan success or nonsuccess.

Number of Years Borrow Had Loans in His Own Name

The number of years a borrower had farm loan contracts in his own name seemed to matter little in terms of satisfactory repayment. One might reasonably expect that continuous borrowing experience in the farmer's own name over a period of 5 to 15 years (the sample averaged about 11 years) would result in either a satisfactory credit relationship or no satisfactory credit relationship. This was not the case with borrowers in the sample. Unsuccessful and successful borrowers averaged about an equal number of years of borrowing in their own names.

Attitude Toward Lender

The lending officers rated all borrowers in the successful group as cooperative in their relationship with the FHA or PCA. Farmers Home Administration officers rated about one-fourth of the unsuccessful group uncooperative and PCA's considered one-eighth uncooperative.

Borrowers With Reasonable Farm Plans

The FHA and PCA lending officers agreed that all the successful, but not all of the unsuccessful, borrowers had made reasonable farm plans for the year ahead. The FHA officers considered 60 percent of their unsuccessful sample group as not having reasonable farm plans without considerable help from the FHA supervisor. About one-fifth of the PCA unsuccessful group did not do a satisfactory job of farm planning. The most common reasons FHA gave for the lack of borrower farm planning were that many had little or no ability to make plans, or there was no desire on the part of the borrower to make plans. Most PCA

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borrowers without usable farm plans were considered as preferring to operate their farms on a day-to-day basis.

Quality of Land Farmed or Grazed

The overall quality of land operated by successful borrowers averaged a little higher than for the unsuccessful borrowers. The difference of quality in favor of the successful group might partially explain why the production record of the successful borrowers was usually much better than that of the other group.

Livestock Losses

In parts of South Dakota where livestock production is important, the frequency of livestock losses directly affects the profitability of the farm or ranch. With both FHA and PCA's, the successful borrowers in the sample had lower livestock losses than did the unsuccessful borrowers.

Attitude Toward Changes in Farming Technology

With the relatively rapid changes in farming through the use of improved methods, machinery, chemicals, and other innovations, it would be reasonable to assume that better operators, when they considered it feasible, would take advantage of available improvements. The loan officers were asked to rate the sample borrowers as to whether they were eager to adopt advanced techniques, average in their attitude toward changes, or actually resisted change.

About half the successful borrowers were rated eager in their attitude toward changes and the other half average. Lenders thought about one-fifth of the unsuccessful borrowers had a negative attitude toward using improvements in their farming business. Two-thirds of the unsuccessful group were rated average and the other one-sixth were judged to be eager to change if they were capable financially or otherwise.

Condition of Dwelling, Service Buildings, Land, Machinery, and Livestock

In general, the successful borrowers had higher percentages of farm-related items, such as land, buildings, and machinery in above-average condition than did the unsuccessful borrowers. It should not matter much to a lender whether being an unsuccessful farm borrower is the cause of, or the result of, the general condition and appearance of his houses, land, or equipment. It is important, however, that the lender know there is a definite relationship and that he properly use that knowledge in future contacts with the farmer.

Farm of Satisfactory Economic Size

Information in the borrower's loan file and results of interviews with the loan officers indicate that about one-fourth of the unsuccessful borrowers operated farms that were not of satisfactory economic scale for their goals or needs. More FHA than PCA borrowers were in this category. Nine percent of the successful borrowers were on farms of unsatisfactory economic size. Of the 9 percent, all

except one borrower operated a farm considered to be too small. One borrower operated a farm larger than he had the managerial ability to handle satisfactorily.

Cooperation of Family in Keeping Living Expenses in Line With Expected Income

The annual net income on individual family farms probably fluctuates from year to year as much or more than that of most occupations. With such uncontrollable variables as weather, yield, prices paid and received, and Government programs, the actual net income received by the farm operator often misses his estimate made earlier in the year. Therefore, the family should adjust its living expenses to the current situation and outlook.

A much larger percentage of the unsuccessful borrowers experienced poorer cooperation from their family in adjusting living expenses. Over one-fourth lived somewhat extravagantly relative to their means. This compared with 2 percent for the successful borrowers. In contrast, some lending officers felt that several unsuccessful and successful borrowers spent too much of their income on the farm business and not enough on their living expenses.

Here, again, there was a scarcity of written information in the loan files to provide such information. Most of the opinions were from the loan officer's general knowledge of the situation and are, therefore, highly subjective.

Insurance Coverage

Many loan files had no information on whether the borrower carried insurance of one kind or another. However, from available data and loan officers' knowledge, there seemed to be only slight variations between the success groups. Practically all loan officers thought their borrowers should have adequate insurance coverage, but they did not consider such coverage a significant factor when appraising a loan application.

Weather Damage

Although statistical tests used in this study found weather to be a minor factor in loan success or failure, additional comments may be justified. Hardly any topic occupies the attention of farmers as much as does weather. Many of the times weather is mentioned, it is mentioned in connection with damage caused to crops, livestock, or buildings. Without going into whether farmers have any defense against sudden spells or lengthy sieges of bad weather, it is true that unsatisfactory weather has been blamed rightly or wrongly for the financial weakening or failure of many farm firms.

In the sample of South Dakota borrowers, 56 percent claimed to have experienced moderately severe or severe damage to their crops and livestock because of unfavorable weather conditions during the course of their FHA or PCA loans. Many of the remaining 44 percent claimed minor weather damage. Sixty-five percent of all unsuccessful borrowers experienced weather damage, compared with 50 percent of all successful borrowers.

More unsuccessful borrowers experienced consecutive years of weather damage (fig. 2). Farmers more or less expect severe weather damage at one time or another in their farming careers. Most of them try to prepare in advance for such occasions. Where most farmers may be able to recover from bad weather years which occur at intervals of, say, every 5 years or so, sometimes damage to the business might be extremely serious if several years of severe weather damage occur consecutively.

Management Ability

There was no good way to measure borrowers' management ability as a separate item. Managerial skills are reflected to a substantial degree in other characteristics, such as output of farm products and cost per unit of output. Loan officers were asked to rate the ability of the sample borrowers in general farm and money management and in livestock and crop production. Generally the FHA had more information of this type and had less trouble rating their borrowers than did the PCA's.

As might be expected, successful borrowers rated higher in each category. Unsuccessful borrowers fared worse in money management than in the other categories.

WEATHER DAMAGE
DAMAGE IN 2 OR MORE CONSECUTIVE YEARS
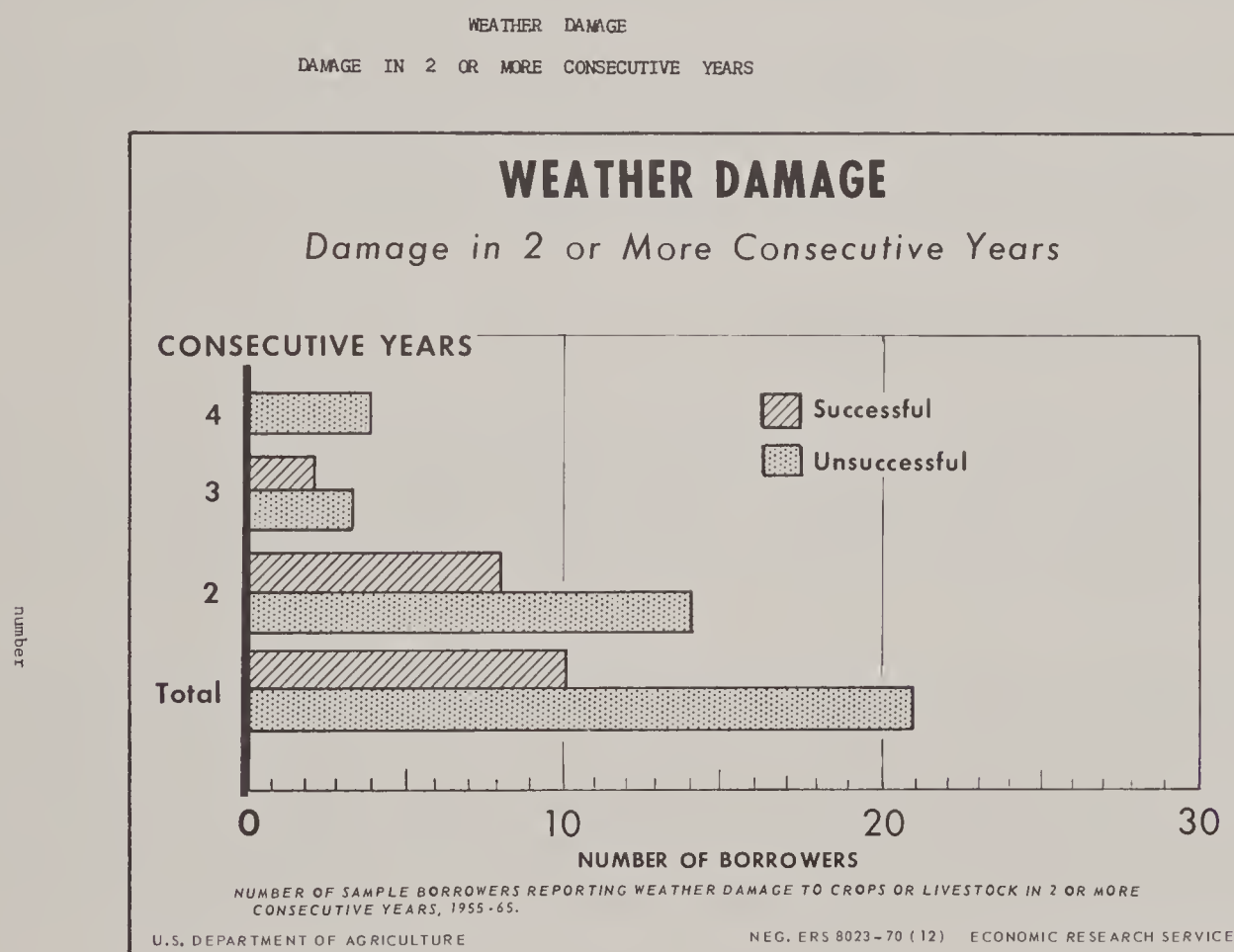
of sample borrowers reporting weather damage to crops or livestock in
2 or more consecutive years, 1955-65

Figure 2

Tendency to Overbuy Machinery or Livestock

A complaint of many lenders is that some borrowers tend to buy either more pieces of machinery or larger machines than they actually need. The tendency to overbuy farm machinery becomes a real problem when not enough income is generated to pay for the machinery or meet scheduled payments. Excessive purchases of livestock were minimal compared with excessive purchases of machinery.

In the opinion of the FHA and PCA lenders, one in three unsuccessful borrowers tended to overinvest in farm machinery, while one in 20 successful borrowers did so. Whether they were FHA or PCA borrowers mattered little. It could be that too large a proportion of cash income went to purchase machinery and left an inappropriate share for other production items.

Too Little Labor, Equipment, or Materials

Trying to farm with inadequate labor and machinery, equipment, fertilizers, or other materials could well have a detrimental effect on the farm's profitability. In the FHA lenders' opinions, from 14 to 20 percent of the sample FHA borrowers were operating with insufficient production inputs. Only from 2 to 4 percent of the PCA borrowers were so judged by the PCA managers. For both lenders, more unsuccessful borrowers than successful were operating with inadequate inputs.

Lenders were of the opinion that had some borrowers not lacked adequate production inputs, they would have had more success with their farm loans. However, FHA county supervisors and PCA managers stated that even with sufficient material inputs, some borrowers would probably not be successful because of other overwhelming causes.

Major Changes Made in Farming

About one-third of each of the three groups of borrowers (FHA borrowers, PCA borrowers, and all borrowers) had made a major farming change within the last several years of loan history. There were differences between FHA and PCA borrowers, however. FHA borrowers tended to change enterprises more than PCA borrowers did.

According to the lending officers, 35 percent of all successful sample borrowers increased the overall size of their farming units. This compared with 29 percent of unsuccessful PCA borrowers and no unsuccessful FHA borrowers increasing the size of the farming unit. Some of the 8 percent of FHA unsuccessful borrowers who increased the size of livestock operation could possibly also have been counted with those who increased the overall farming unit.

For all sample borrowers, about twice as many successful borrowers increased the size of their farming units. Fewer successful borrowers changed from one kind of farm enterprise to another.

Item	Unit	FHA		PCA		Total	
		50 Successful	50 Unsuccessful	50 Successful	50 Unsuccessful	100 Successful	100 Unsuccessful
Borrower's age at last year of loan (avg.)	Years	37.4	40.2	42.6	45.1	40.0	42.7
Wife's age at last year of loan (avg.)	do.	33.7	35.0	37.6	41.3	35.6	38.2
Borrowers married	Number	49	49	47	49	96	98
Persons in borrower's household (avg.)	do.	5.0	6.2	4.5	5.1	4.7	5.6
Who helped on farm	do.	2.0	2.6	1.8	1.8	1.9	2.2
Borrowers working off farm:							
At first application	do.	27	29	7	12	34	41
At last application	do.	8	22	10	18	18	40
At both times	do.	4	15	4	7	8	22
In steady off-farm work	do.	2	9	6	11	8	20
In seasonal off-farm work	do.	6	18	4	7	10	25
Years working off farm	Years	4.1	4.5	7.0	5.5	5.7	4.9
Borrowers with another business	Number	1	3	4	---	5	3
Store	do.	---	---	1	---	1	---
Public office	do.	---	---	1	---	1	---
Other	do.	1	3	2	---	3	3
Percentage of borrowers with a change in their households	Percent	65	62	54	56	59	59
Number change (increase)	Number	2.2	2.2	1.6	2.5	1.9	2.3
Number change (decrease)	do.	2.0	2.1	1.7	2.1	1.8	2.1
Number of active workers lost	do.	3	2	2	9	5	11
Borrowers with a death in their household	do.	1	1	---	3	1	4
Number for whom death--							
Severely hurt business	do.	---	1	---	---	---	1
Hurt business but not severely	do.	---	---	---	2	---	2
Borrowers with a serious illness in their family	do.	4	9	2	4	6	13
Number for whom illness--							
Severely hurt business	do.	1	4	1	1	2	5
Hurt business but not severely	do.	3	4	1	2	4	6
Borrowers physically handicapped	do.	3	6	1	4	4	10
Borrowers receiving family help	do.	2	3	6	1	8	4
Kind of help:							
Real estate	do.	---	---	3	---	3	---
Cash	do.	---	2	1	---	1	2
Use of machinery at little or no cost	do.	---	---	1	---	1	---
Real estate and cash	do.	---	---	---	1	---	1
Chance to buy farm from family at low cost	do.	1	1	1	---	2	1
Other	do.	1	---	---	---	1	---
Highest formal education of borrowers:							
Elementary	do.	18	26	8	12	26	38
High school	do.	30	23	35	33	65	56
College	do.	2	1	5	2	7	3
Unknown	do.	---	---	2	3	2	3
Borrowers living on farm operated	do.	50	50	48	50	98	100
Years borrower had been farming at time of last loan application (avg.)	Years	11.9	15.9	19.4	21.7	15.5	18.7
Years borrower had been in area (avg.)	do.	10.0	14.0	18.8	20.0	14.3	16.8
Years borrower had been in farming business arrangement (avg.)	do.	7.6	10.0	13.9	13.2	10.6	11.5
Borrowers with farm in 2 tracts	Number	21	19	18	17	39	36
Distance farms apart (avg.)	Miles	7.1	3.5	5.6	3.9	6.4	3.7
Acres cropland rented in (avg.)	Acres	308	306	271	248	289	277
Acres rangeland rented in (avg.)	do.	415	351	629	678	575	513
Percentage of borrowers with a recent major expansion in farming	Percent	34	8	34	39	34	23
Years borrower had borrowed in his own name	Years		14.9	16.9	14.7	13.4	14.8
Percentage of borrowers for whom credit references were obtained	Percent		94	98	94	94	94
Percentage of borrowers cooperative in dealing with lender	do.		76	100	88	100	82
Borrowers with poor farm plans or no farm plans 2/	Number	---	27	---	7	---	34
Reasons:							
No ability to plan	do.	---	8	---	1	---	9
No desire to plan	do.	---	9	---	1	---	10
Does not follow through	do.	---	2	---	---	---	2
Operates day to day	do.	---	5	---	4	---	9
Depends on judgment of lender	do.	---	---	---	1	---	1
Other	do.	---	3	---	---	---	3
Percentage of borrowers who had changed types of farming	Percent	34	18	34	18	34	18

See footnotes at end of table.

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Item	Unit	FHA		PCA		Total	
		50 Success-ful	50 Unsuccess-ful	50 Success-ful	50 Unsuccess-ful	100 Success-ful	100 Unsuccess-ful
Percentage of borrowers with farmed land:							
Above average in quality	do.	18	10	24	10	21	10
Average in quality	do.	78	80	68	74	73	77
Below average in quality	do.	4	10	8	16	6	13
Percentage of borrowers with grazed land:							
Above average in quality	Percent	16	8	40	12	28	10
Average in quality	do.	80	12	58	76	69	44
Below average in quality	do.	4	80	2	12	3	46
Percentage of borrowers with production records:							
Above average in quality	do.	54	4	42	4	48	4
Average in quality	do.	40	46	56	64	48	55
Below average in quality	do.	6	50	2	32	4	41
Percentage of borrowers with a change in production record	do.	20	16	26	38	23	27
Number with a higher record	Number	8	3	13	4	21	7
Number with a lower record	do.	2	5	---	15	2	20
Percentage of borrowers with livestock losses:							
Below average	Percent	58	4	15	7	36	6
Average	do.	38	60	64	37	51	48
Above average	do.	4	36	6	6	5	21
Percentage of borrowers with dwelling:							
In good condition	do.	56	52	72	50	64	51
In fair condition	do.	40	44	26	42	33	43
In poor condition	do.	4	4	2	8	3	6
Percentage of borrowers with other buildings:							
In good condition	do.	56	38	64	42	60	40
In fair condition	do.	40	50	36	50	38	50
In poor condition	do.	4	12	---	8	2	10
Percentage of borrowers with machinery:							
In good condition	do.	38	40	72	50	55	45
In fair condition	do.	60	52	26	40	43	46
In poor condition	do.	2	8	2	10	2	9
Percentage of borrowers with livestock:							
In good condition	do.	80	26	100	72	90	49
In fair condition	do.	20	62	---	24	10	43
In poor condition	do.	---	12	---	4	---	8
Percentage of borrowers with land:							
Of good quality	do.	58	44	68	50	63	47
Of fair quality	do.	42	52	32	48	37	50
Of poor quality	do.	---	4	---	2	---	3
Percentage of borrowers:							
Unable to get credit	do.	4	24	---	16	2	20
With a high cost of operation	do.	2	54	2	46	2	50
Having too little labor, equipment, etc.	do.	14	20	2	4	8	12
With farm size of satisfactory economic size	do.	88	62	92	74	90	74
Not receiving cooperation from family in adjusting to living expenses	do.	---	34	---	10	---	22
Handling living expenses extravagantly	do.	4	32	---	22	2	27
Spending too much income on farm operation	do.	4	4	4	14	4	9
Tending to overbuy machinery or livestock	do.	6	30	4	36	5	33
Adjusting to income situation	do.	92	64	92	64	92	64
Number of borrowers: 2/							
With credit life insurance	Number	21	14	25	44	46	58
Without credit life insurance	do.	20	22	13	3	33	25
With life insurance	do.	36	25	44	38	80	63
Without life insurance	do.	4	8	2	3	6	11
With crop insurance	do.	16	13	19	23	35	36
Without crop insurance	do.	19	20	10	6	29	26
With livestock insurance	do.	19	13	38	31	57	44
Without livestock insurance	do.	11	17	6	5	17	22
With health and accident insurance	do.	27	27	40	40	67	67
Without health and accident insurance	do.	10	13	4	3	14	16
With liability insurance	do.	24	23	48	47	72	70
Without liability insurance	do.	14	15	0	2	14	17
With losses from fire	do.	1	4	---	1	1	5
With no losses from fire	do.	49	46	50	49	99	95
With losses covered by insurance	do.	1	3	---	1	1	4
With losses not covered by insurance	do.	---	1	2	2	2	3
With liability suits 2 or 3 years prior to study	do.	---	---	3	---	3	---
With no liability suits 2 or 3 years prior to study	do.	50	50	46	48	96	98

See footnotes at end of table.

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Item	Unit	FHA		PCA		Total	
		50 Success-ful	50 Unsuccess-ful	50 Success-ful	50 Unsuccess-ful	100 Success-ful	100 Unsuccess-ful
Borrowers who suffered damage because of weather......:	Number	26	35	24	30	50	65
Borrowers' ability to manage--							
Farm--							
Poor...:	do.	1	25	---	9	1	34
Average..:	do.	26	24	2	37	28	61
Good...:	do.	23	1	48	4	71	5
Money--2/							
Poor...:	do.	1	36	---	20	1	56
Average..:	do.	27	13	6	19	33	32
Good...:	do.	22	---	36	2	58	2
Livestock operation--2/							
Poor...:	do.	1	23	---	5	1	28
Average..:	do.	22	25	1	23	23	48
Good...:	do.	27	---	42	8	69	8
Crops--2/							
Poor...:	do.	1	20	0	3	1	23
Average..:	do.	29	29	0	19	29	48
Good...:	do.	20	---	25	---	45	---
Borrowers' opinions toward future in farming:							
Will get out...:	do.	1	28	---	14	1	42
Undecided..:	do.	3	14	1	23	4	37
Will stay..:	do.	46	8	49	13	95	21
Borrowers' attitudes toward changes in farming technology:							
Eager..:	Percent	50	6	48	22	49	14
Average..:	do.	50	58	52	76	51	67
Resisting..:	do.	---	36	---	2	---	19

1/ Some data are as of the time of the first or last loan application; other data refer to the period from first to last loan application, inclusive.

2/ Numbers may not add to 50 or 100 because for some borrowers information was not known.

CONCLUSIONS

Results of this study are conclusive enough that they can be used advantageously in some form by lenders. It is likely that different factors would be of importance in different parts of the country or for different types of farms. So, the actual items or factors used in analysis would vary from those used here. Nevertheless, it is plausible that a running record of several pertinent factors would flash warning signals before loans deteriorated to uncompromisable conditions. The warning system would naturally improve as lending officers gained experience and accumulated series of data most applicable to their particular type of loans.

No significant differences in borrower or loan characteristics were found at the time of the first loan application. If all loans in the sample began in acceptable condition, but some ended unsuccessfully, then either (1) something took place in the interim that greatly affected the quality of some loans, or (2) there were characteristics present at the time of the first application that were not correctly evaluated or known. Tests demonstrated that measurable differences did develop during the interim.

The hypothesis that certain characteristics were not properly evaluated at the time of first application was not tested. However, study results strongly imply that lenders can improve loan performance by having more thorough information about borrowers when the first loan requests are being considered. Financial and production factors, which are all quantitative, show some promise of being indicators of potential loan success. The qualitative items are difficult to measure but, as the results show, are extremely important in the evaluation.

SUGGESTIONS FOR FURTHER RESEARCH

The techniques used in this study seem to hold reasonable possibilities for further research in farm loan quality. The discriminant function analysis lends itself fairly well to distinguish important differences between the means of two groups such as successful and unsuccessful borrowers. The further refinement of being able to rank the differences as to importance in the mix tested is of particular value.

The variables to be included in the analysis should be chosen with care. Variables need not be large in number but should be clearly distinct in what they are to depict. In this study, absolute amounts--such as value of assets and debts and number of acres farmed--were not as satisfactory as ratios (for example, as ratios of debts to assets and debts to value of land farmed). Absolute numbers will most likely vary much more among borrowers than ratios and will be more difficult to analyze.

Loan quality deterioration does not usually develop from the effect of a single factor but from the interaction of several factors. Through further research, a method might be devised permitting arrangement of analysis results into a score system that would indicate when loan quality was entering the danger zone.

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A set of variables that includes loan information such as amount loaned per year, renewal rate, and other loans refinanced, might well help select out one or more important indicators. The same would be true of farm and nonfarm income data. Again, care should be taken to select items that would be common among almost all borrowers or loans under study. Factors suspected of association with low-quality loans, but for which inclusion is not possible for all or almost all borrowers, would not fit well in this particular method of analysis.

The testing of data periodically over a time period might prove worthwhile. Analysis of historical data on an annual basis similar to the analysis of the last year of the loan, as was done in this study, would be highly indicative of the value of a loan officer keeping a current running record of some selected indicators.

The possibilities of analysis of farm loans and borrower characteristics are many. However, it should be emphasized that regardless of variables and techniques used, every test result must be weighed with other information. Although they may be similar on some counts, farm operating loans are not the same as ordinary consumer loans. If a borrower does not get a particular consumer loan, it may only mean that he has to forego the purchase of a particular car, refrigerator, or television set. Whether he gets a farm operating loan may spell the difference between farming another year or making his family's livelihood some other way.

APPENDIX

The statistical analysis in this study was concerned with differentiating between two classes of farm borrowers--essentially, those successful in repaying loans and those unable to repay satisfactorily. A number of measurable characteristics or factors were used to search for meaningful differences.

Discriminant function analysis provides a method of measuring the difference between means of the two groups and testing the difference for statistical significance. Also, the results permit further testing to weight the characteristics according to their relative importance.

A linear discriminant function of the general form

$$Z = g_1 X_1 + g_2 X_2 + \ldots g_p X_p$$

was used to estimate the coefficients (g_i) for p variates (X), assuming multivariate normal distributions of the variables with equal variances and covariances but differing means.[4] These assumptions may not be entirely met with these two populations, but this procedure provides a useful approximation. A value of 1 or 0 was assigned to Z, depending upon whether the observation was in group A (unsuccessful borrowers) or group B (successful borrowers).

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[4] For an expansion on the theory of discriminant functions, see David Durand, Risk Elements in Consumer Installment Financing, Appendix A, National Bureau of Economic Research, technical edition, 1941.

The discriminant function analysis results of all 100 unsuccessful and all 100 successful borrowers were:

$$Z = .00018X_1 + .00131X_2 - .00075X_3 + .00488X_4 + .00132X_5 + .00032X_6$$
$$+ .01181X_7 - .01573X_8 + .00056X_9 - .01732X_{10} + .00017X_{11} + .01120X_{12}$$
$$+ .00646X_{13} + .02505X_{14} - .00486X_{15}$$

Where X_1 = age

X_2 = number in household

X_3 = off-farm income (1 - Yes, 2 - No)

X_4 = family help (1 - Yes, 2 - No)

X_5 = education (1 - elem, 2 - high school, 3 - college)

X_6 = number of years farming

X_7 = production record (1 - above average, 2 - average, 3 - below average)

X_8 = high cost of operation (1 - Yes, 2 - No)

X_9 = weather damage (severity code 1 - 9)

X_{10} = ratio - net worth to total assets

X_{11} = ratio - total debt to net worth

X_{12} = ratio - non-real estate debt to total debt

X_{13} = ratio - total debt to total assets owned

X_{14} = ratio - non-real estate debt to non-real estate assets

X_{15} = ratio - total debt to total assets operated

The coefficients may be interpreted as probabilities. For example, .00018 for X_1 says that as age increases 1 year, the probability that the borrower will be unsuccessful increases .00018.

The discriminant function analysis of the 50 unsuccessful and 50 successful FHA borrowers gave the following results:

$$Z = .00016X_1 + .00250X_2 - .00375X_3 - .01585X_4 + .00170X_5 + .00116X_6$$
$$+ .03151X_7 - .04746X_8 + .00125X_9 - .06979X_{10} + .00052X_{11} + .06033X_{12}$$
$$- .04624X_{13} + .06871X_{14} + .06340X_{15}$$

Results of the discriminant function analysis of the 50 unsuccessful and 50 successful PCA borrowers were:

$$Z = .00094X_1 + .00376X_2 - .00687X_3 + .02754X_4 - .00105X_5 - .00005X_6$$
$$+ .02029X_7 - .02789X_8 + .00167X_9 + .00460X_{10} - .00994X_{11} + .02838X_{12}$$
$$+ .17925X_{13} + .02822X_{14} - .06389X_{15}$$

In addition to determining the coefficients for the variables in the discriminant function, a method of ranking the variables by importance was needed.

In this study, a statistic W was developed as follows:

$$W = 1 - \frac{D^2_{p-1}}{D^2_p}$$

Where $D^2_p - 1$ is calculated using p-1 variables $X_1, \ldots X_{i-1}, \ldots X_{i-1}, \ldots$ $X_j = 1, X_{j+1}, \ldots X_p$ and D^2_p is calculated using p variables
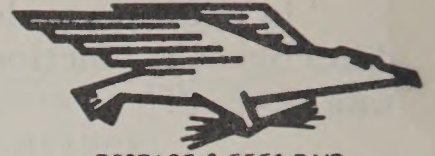
$$X_1, \ldots, X_p$$

Where X_i are the variables with observations from group A, and X_j are variables with observations from group B, and i = j for all D^2. The larger the value of the statistic W, the more important the variable (X) in measuring the distance between the means of groups A and B.

The index (W) measures the "cost" to the lender in evaluating a borrower if he lacks the information contained in variable X or fails to use the information if available.